



**CLOSED CIRCUIT TELEVISED INSPECTION PROGRAM  
FOR THE  
JONES FALLS SEWERSHED**

**CITY OF BALTIMORE PROJECT NO. 994**



**CCTV REVIEW MANUAL**

**JONES FALLS COLLECTION SYSTEM  
EVALUATION AND SEWERSHED PLAN  
CITY OF BALTIMORE PROJECT 994**

**PREPARED BY**

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**CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED**

The Following Conventions Shall Be Used When Reviewing CCTV Data Submitted For The Jones Falls Sewershed

**QUALITY CONTROL (QC) REVIEW TAB**

**OBJECTIVE:** The objective of CCTV inspection program completed for this project will be to internally inspect and evaluate all sanitary sewers 8-inches and larger in diameter and assist in updating the GIS. Where practical the CCTV inspections will be conducted in such a manner that provides an unobstructed view of the complete interior of the pipe being inspected. The National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) was selected by the City of Baltimore for use on this project. The first objective of the PAC Program is to fully document all structural deficiencies and construction features in the sewer segment being investigated since those defects will have a long term influence on the pipe's overall condition and integrity. When the sewer is inspected, the pipe should be free of excessive flow, steam, debris and/or obstructions and provide sufficient lighting that will not impede visibility and allow for a complete inspection and interpretation of the pipes condition. All defects should be coded per the PAC Program guidelines, version 3.0.2 or later. A reasonable effort shall be made by the CCTV contractors to fully inspect the entire pipe segment before the survey is considered abandon.

**QC REVIEW TAB**

The screenshot shows a software window titled "CCTV Survey U0171 Review" with a close button (X) in the top right corner. The window has four tabs: "QC Review" (selected), "O&M Review", "Rehab Review", and "GIS". Below the tabs is a text input field. Underneath the field are two radio buttons: "Accepted" (selected) and "Rejected", followed by a "Clear" button. A section titled "CCTV Survey Issues" contains a list of checkboxes, all of which are currently unchecked: "Excessive flow", "Poor Lighting", "Camera not centered", "Image Quality/Distortion", "Significant defect not noted", "Excessive camera movement", "Excessive camera speed", "Color", and "Overlay problem". At the bottom of the window are "Save" and "Cancel" buttons, and a red pushpin icon in the bottom right corner.

## CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED

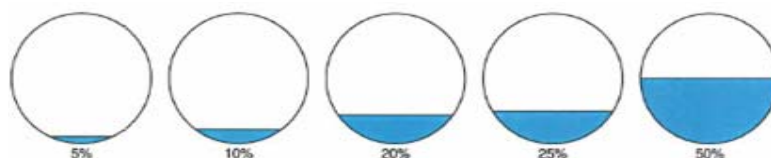
**Excessive Flow:** Excessive flow level in a pipe is described as flow levels that obstruct the inspection camera from providing a clear and unobstructed view/image of the interior of the pipe for evaluation. For the purpose of this project, an inspection will be considered acceptable if the inspection camera proceeds in excessive flow (sag in a pipe) for short distances assuming the pipe before and after the sag is in serviceable condition. Inspections will not be accepted when a CCTV camera operator attempts to turn the inspection camera to the side or attempts to ride-up the side of the pipe to keep the camera above the flow line. If the pipe dips underwater at any point during the survey an "MCU" code should be noted and if the camera is underwater for more than 10% of the total length of the pipe being surveyed, the survey should be failed and marked as "Excessive Flow". The following criteria is outlined in the PACP manual and shall be used for determining acceptable and unacceptable flow conditions in a pipe segment during the inspection process:

### Pipe Size

6" to 10" Pipe  
12" to 24" Pipe  
24" And Up

### Maximum Depth of Flow

No More Than 20% of the Pipe Diameter  
No More Than 25% of the Pipe Diameter  
No More Than 30% of the Pipe Diameter

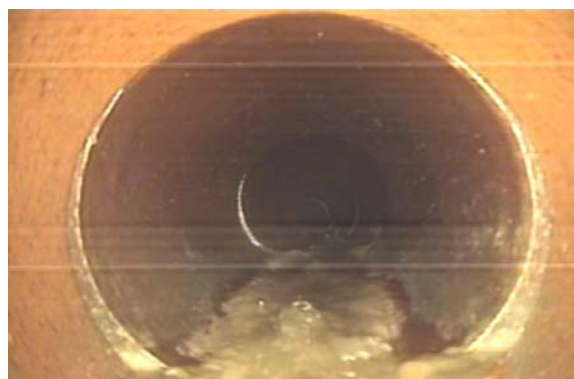


Acceptable Flow Level (Flow Below Camera)

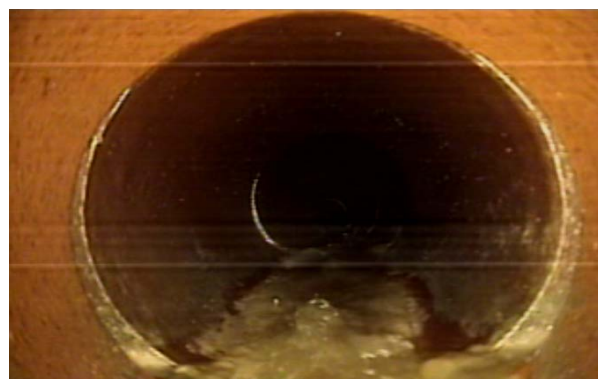


Unacceptable Flow Level (Can't See Entire Pipe)

**Poor Lighting:** Lighting during the inspection should be adequate to fully illuminate the entire pipe section in view of the CCTV camera, but not over illuminate the image where as to create distortion of the image. Low lighting will likely occur in larger diameter pipes or when dark pipe materials such as HDPE, DIP, etc. was used in the construction of the system. In order for an inspection to be considered acceptable, the complete interior of the pipe must be visible to detect and code all defects, etc.



Acceptable Lighting For Inspection



Unacceptable Lighting For Inspection

## CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED

**Camera Not Centered:** In order to provide a complete and unobstructed view of the pipe for inspection, the camera must be appropriately sized and centrally positioned to adequately view the complete interior of the pipe being inspected. This means the camera should be centered both vertically and horizontally in the pipe being inspected and the complete interior of the pipe must be visible for inspection.



Camera/Image Not Centered



Camera/Image Adequately Centered

**Image Quality/Distortion:** In order to provide a complete and thorough inspection of the pipe, the inspection camera must provide an image that is clear and not distorted by flow levels, water, steam or debris on the camera's lens. The camera must be centered in the pipe so as not to exaggerate the image (i.e. amount of offset in joints, pipe ovality, etc). The image must be clear and allow for a thorough visual inspection and interpretation of the interior of the pipe.



Clear/Acceptable Image Quality



Distorted/Unacceptable Image Quality



## CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED

Significant Defect Not Noted: A Significant Defect Not Noted (PACP Structural, O&M, Construction & Miscellaneous Features) should be defined as a defect that has not been recorded as part of the inspection but impacts the structural condition of the pipe or requires system maintenance. These include structural defects such as cracks, holes, offset joints, roots, etc. and maintenance related items such as grease and debris. These defects should always be coded per the PAC Program requirements. Note: some of the PAC Program codes contain threshold limit values such as joint offsets and defects. Other defects may require judgments by the observer/reviewer whether to code or not. Defects that appear to be only cosmetic in nature and DO NOT impact the structural integrity or the operation of the sewer do not require coding. As a general rule, if more than 3 significant defects are not coded, then the inspection should be rejected.

### Examples of Significant Structural Defects That Should Be Noted:

Cracked Pipe (C): Longitudinal (CL), Circumferential (CC), Multiple (CM)  
 Fractured Pipe (F): Longitudinal (FL), Circumferential (FC), Multiple (FM)  
 Broken Pipe (B)  
 Hole in Pipe (H)  
 Deformed Pipe (D): Vertical (DV)  
 Collapsed Pipe (XP) / Brick (XB)  
 Joint Offset (JO), Joint Separated (JS), Joint Angular (JA),  
 Surface Damage (S): Reinf. Visible (SRV), Reinf. Projecting (SRP), Reinf. Corroded (SRC), Missing Wall (SMW)  
 Lining Failure (LF)  
 Missing Mortar (MM)

\* Use of Continuous Defect Coding: A continuous defect is any defect that extends or is repeated beyond the first 3-feet of the camera's position or when at least 75% of the joints (3 out of 4) are affected in a pipe.

### Examples of Significant Operational and Maintenance Defects That Should Be Noted:

Deposits - Attached (DA), Deposits - Settled (DS)  
 Roots (R): Fine (RF), Tap (RT), Medium (RM), Ball (RB)  
 Infiltration (I) - All Types  
 Obstacles/Obstructions (OB) - All Types

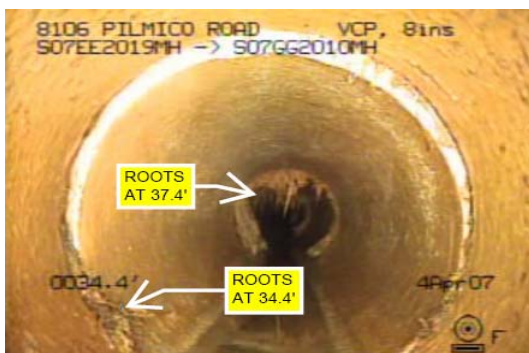
### Examples of Significant Construction Feature Defects That Should Be Noted:

Tap (T), Intruding (TI), Defective (TFD), Break-in / Hammer Conn. (TB)

### Examples of Significant Miscellaneous Features Defects That Should Be Noted:

Miscellaneous Shape Change (MSC)  
 Mean Water Level - Sag (MWLS)

### Example of PACP Coding Error

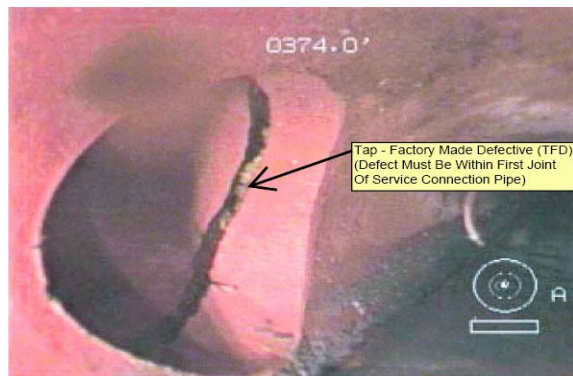


Significant Defect (Roots) In Pipe Not Noted

0.0	ST					
0.0	AMH					
0.0	MWL		5			
3.1	MWLS		10			
10.8	RFJ				03	
13.1	RFJ				08	04
16.6	S01 RFJ				03	
20.6	H				03	
55.6	TFA	6.0			03	
73.7	TFA	6.0			03	
92.0	JOM					

Significant Defect (Roots) Not Noted

## CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED



Example of Tap - Factory Made Defective (TFD)



Example of Defect Located Outside Tap - Factory Made (Code as TF - Then Indicate In Comment "DEFECT")



## Continuous Defects – Coding

Enter distance the defect starts

Enter defect code and any other associated information i.e. clock reference

Enter continuous defect number

Distance (feet)	Video Ref	Code		Continuous defect	S/M/L	Value			Joint	Circumferential location	
		Group / Descrip	Modifier / severity			1st	2nd	%		At / from	To
36.0		IR		S 01					J	08	04
89.7		IR		F 01					J	08	04



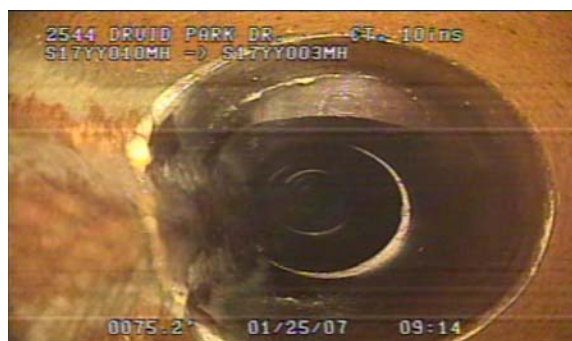
Continuous Defect Coding - If a Continuous Defect Is Started (S 01) It Must Be Closed (F 01)

## CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED

**Excessive Camera Movement:** The CCTV camera should always be centered in the middle of the pipe and the camera head not excessively panned or zoomed during the inspection. The camera should be stopped and centralized on defects while the operator views and records the defects. The operators objective in positioning the camera should be to provide a perspective similar to that found in the PAC Program reference manual.



Acceptable Image - Centered In Pipe



Unacceptable Image - Image Rotated To Side

**Excessive Camera Speed Is Described As:** The CCTV camera should always be centrally located in the middle of the pipe being inspected and should not exceed 30-feet per minute in forward progression.

**Image Color:** The CCTV camera should record all inspection images in color allowing the observer to review details of the inspection. Color images allow the observer to determine items such as pipe material, lining installation, severity of defects, etc. which otherwise could not be detected with a black and white image. Any inspections completed in black and white will not be accepted.



Acceptable Color Inspection

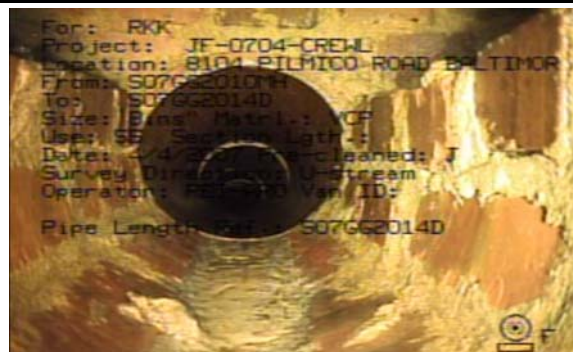


Unacceptable Black & White inspection

**Overlay Defects:** All video overlay images shall be clearly visible to the reviewer and include all PAC Program defined items. Overlay color that is not clearly visible over the image will not be acceptable. The camera length image shall always be visible by the reviewer so defect locations can accurately be noted.



Acceptable Overlay (Entries Can Be Seen)



Unacceptable Overlay (Entries Can't Be Seen)

The Following Conventions Shall Be Used When Reviewing CCTV Data Submitted For The Jones Falls Sewershed

**O&M REVIEW TAB**

The screenshot shows a software window titled "CCTV Survey U0171 Review" with a standard Windows-style title bar (minimize, maximize, close buttons). Below the title bar is a tabbed interface with four tabs: "QC Review", "O&M Review" (which is selected), "Rehab Review", and "GIS". The "O&M Review" tab contains a list of seven items, each with an unchecked checkbox:

- ☐ Lateral cleaning/debris removal
- ☐ Mainline cleaning/debris removal
- ☐ Lateral grease removal
- ☐ Mainline grease removal
- ☐ Lateral root removal
- ☐ Mainline root removal
- ☐ Relieve surcharge

Below the list is a large, empty rectangular area, likely for a video feed or additional notes. At the bottom of the window are two buttons: "Save" and "Cancel". In the bottom right corner, there is a small red icon of a fire hydrant. A "Clear" button is located in the top right corner of the main content area, next to a text input field.



# MANHOLE INSPECTION TERMS FOR THE JONES FALLS SEWERSHED

The Following Images Are Examples Of Entries Available On The O&M Tab Of The CCTV Review Program. Use The Following Images As Guidelines Of How To Record These Items.



Lateral Cleaning/Debris Removal



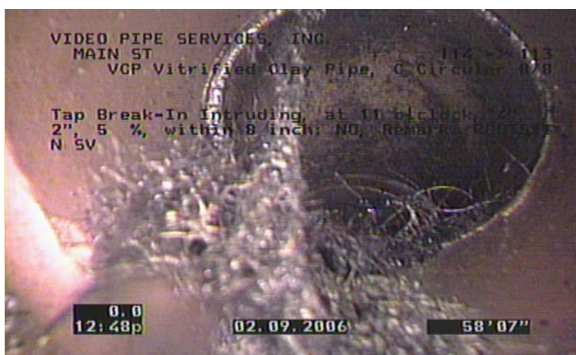
Mainline Cleaning/Debris Removal



Lateral Grease Removal



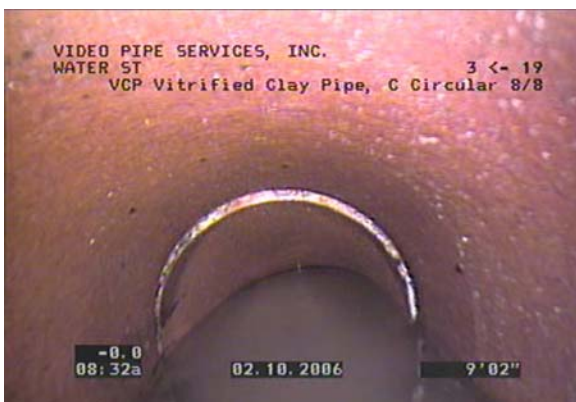
Mainline Grease Removal



Lateral Root Removal



Mainline Root Removal



Relieve Surcharge



**CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED**

The Following Criteria Shall Typically Be Used When Recommending Rehabilitation Or Repairs For Sewers In The Jones Falls Sewershed

**REHABILITATION REVIEW TAB**

The screenshot shows a software window titled "CCTV Survey U0171 Review" with a close button (X) in the top right corner. Below the title bar is a tabbed interface with four tabs: "QC Review", "O&M Review", "Rehab Review" (which is the active tab), and "GIS".

Inside the "Rehab Review" tab, there is a search bar at the top with a "Clear" button to its right. Below the search bar is a list of nine rehabilitation options, each preceded by an unchecked checkbox:

- ☐ Line entire sewer segment (MH to MH)
- ☐ Insitu spot repair
- ☐ Point repair (Dig up and replace section of pipe)
- ☐ Lateral connection repair
- ☐ Lateral repair (Lateral damage only)
- ☐ Grout pipe joints
- ☐ Obstruction removal
- ☐ Remove sag in pipe
- ☐ Cut intruding sewer connection

Below the list is a large, empty rectangular area with a vertical scrollbar on the right side. At the bottom of the window are two buttons: "Save" and "Cancel". In the bottom right corner, there is a red pushpin icon.

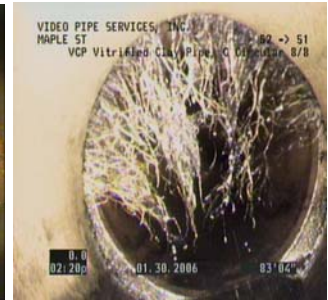
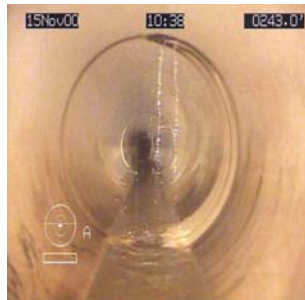


## CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED

### LINE ENTIRE SEWER SEGMENT (MH TO MH)

Typically, the entire sewer segment will be recommended for lining if the following criteria is met:

- If Multiple Cracks (Circumferential, Longitudinal, Multiple) Are Present In At Least 30% Of The Pipe Segment
- If Active or Signs Of Infiltration Are Present In At Least 30% Of The Sewer Segment
- If Offset Joints Are Present In At Least 30% Of The Sewer Segment
- If Roots Are Present At More Than 20% Of The Joints



### POINT REPAIR (DIG-UP)

Typically, point repairs (dig-up to repair) should be recommended when a pipe is collapsed or the pipe cannot be repaired in-place. The following should be used as general criteria for the point repair:

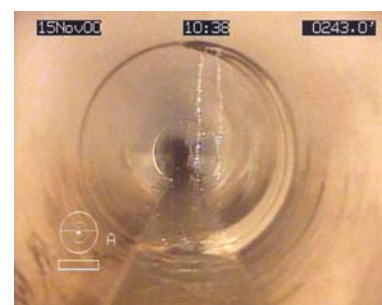
- Pipe is collapsed or an object is in the pipe
- Holes are present in the pipe and soil has entered the pipe
- Pieces of pipe are missing and soil has entered the pipe
- The ovality of the pipe exceeds 15%



### INSITU SPOT REPAIR

Typically, Insitu type spot repairs should be recommended if the following criteria is met:

- Holes are present in the pipe where soil is visible but has not entered the pipe
- Pieces of pipe are missing and soil surrounding the pipe is visible but has not entered the pipe
- Severe cracking of the pipe is present in an isolated section not greater than 6-feet in length
- The ovality of the pipe does not exceed 10-15%



## CCTV DATA REVIEW FOR THE JONES FALLS SEWERSHED

## LATERAL CONNECTION REPAIR

Typically, lateral connection repairs are recommended where defects are located directly at the lateral/service connection to the mainline sewer pipe. This is considered to be to the joint of the service connection. It is common to have as much as 30% of your total system I/I enter the collection system at this location. Therefore it is important to identify these deficiencies for repair.



## LATERAL REPAIR (LATERAL DAMAGE ONLY)

Typically, repairs to the lateral connection piping should be recommended if the piping (located after the initial connection joint to the mainline sewer) shows signs of deterioration or I/I. Again, service connection deficiencies typically represent as much as 30% of a systems total I/I. The following criteria shall be met to recommend lateral repairs:

- Offset joints in the service connection piping at or past the connection point to the mainline sewer
- Roots are present in the lateral
- Active or signs of infiltration are present in the lateral



## GROUT PIPE JOINTS

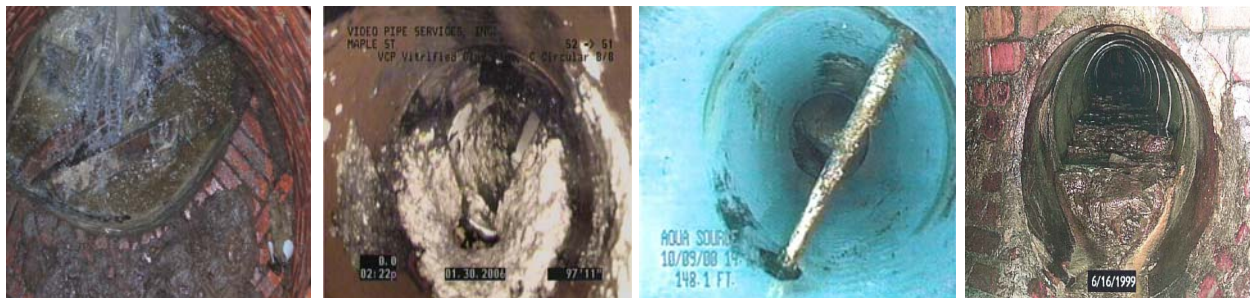
Typically, joints or other infiltration points identified during the CCTV inspections should be recommended for pressure grouting if the following criteria is met:

- Active infiltration is identified in cracks or pipe joints
- Signs of infiltration such as wall staining, calcification, cracks, etc. are identified
- Offset pipe joints are present that show signs of deterioration, cracks or infiltration





The presence of medium to large sized obstacles or obstructions that are likely to cause a serious obstruction to the flow of the sewer and reduction in hydraulic capacity should be recommended for removal.



Sags or low sections in a sewer should be identified as part of all CCTV inspections. A sag is defined as a condition where the grade of the sewer pipe is not continuous and results in water being trapped by the reverse grade change. Typically large sags or low points in a sewer segment which constitute a 30% cross sectional increase in the continuous flow level of the pipe should be recommended for correction to improve the hydraulic characteristics of the sewer.



0.0		ST					
0.0		AMH					
0.0		MWL		4			
32.5	S01	RFJ			J	08	
87.7		TFA	6.0				09
87.7		RFL					
91.8	F01	RFJ			J	08	
91.8		RMJ		25	J	03	
99.2	S02	RFJ			J	12	02
135.9		MWLS		45			
145.3		MCU					
153.8	F02	RFJ			J	12	02
153.8		MSA					
154.1	S03	RFJ			J	03	
154.1	S04	RFJ			J	09	
168.9	F03	RFJ			J	03	
169.6	F04	RFJ			J	09	
170.0		AMH					
170.0		FH					

Intruding service connections or sometimes called "Hammer Taps" are caused when a retrofit service connection is installed into the mainline sewer. These typically extend into the mainline sewer 2-inches or more. These need to be identified and removed if they extend to such a degree that they impede flows, prevent the inspection camera from passing the lateral, or if a lateral repair or CIPP liner is recommended for the sewer segment.

